Claims:

What is claimed is:

1. A method of coating a surface of a substrate with a polymer solution, comprising:

mounting the substrate inside an enclosed housing;

controlling a solvent vapor concentration of a control gas to be greater than approximately 50% (saturation);

passing the control gas into the housing through an inlet;

extruding the polymer solution onto the surface of the substrate in the housing;

spinning the substrate; and

exhausting the control gas and any solvent vapor and particulate contaminants suspended in the control gas from the housing through an outlet.

2. The method of claim 1, wherein the substrate is a wafer having a top surface, a center, and an outer edge; and

wherein extruding the polymer solution comprises extruding a ribbon of photoresist, the ribbon having a width, the ribbon covering the entire top surface of the substrate in a spiral pattern, wherein the photoresist is extruded from the extrusion slot at a rate which is a constant extrusion rate, and with the substrate rotating at a rotational speed, and the extrusion head moving at a radial speed, the motion of a radially moving extrusion head with respect to the rotating substrate is at a tangential velocity which is a constant tangential velocity.

3. A method according to claim 2, wherein the ribbon of photoresist is extruded in a spiral pattern beginning at the outer edge of the wafer and ending at the center of the wafer.

4. A method according to claim 2, wherein the ribbon of photoresist is extruded in a spiral pattern beginning at the center of the wafer and ending at the outer edge of the wafer.

5. A method according to claim 2, wherein the width of the photoresist ribbon is between about one tenth and about one third of the diameter of the wafer.

6. The method of claim 1, wherein:

the substrate is a wafer having a top surface, a center, a diameter, and an outer edge;

mounting the substrate inside an enclosed housing includes mounting the wafer on a chuck, the top surface of the wafer aligned horizontally and oriented upward; and

extruding the polymer solution comprises:

positioning an extrusion head adjacent to the outer edge of the wafer and above the top surface of the wafer, the extrusion head configured to extrude photoresist out an extrusion slot, the extrusion slot having a length

bounded by a first end and a second end, the extrusion head positioned with the extrusion slot aligned radially with respect to the wafer, the first end of the extrusion slot located adjacent to the outer edge of the wafer, and the second end of the extrusion slot outside the outer edge of the wafer,

rotating the wafer about its center, wherein with the wafer rotating at a rotational speed, and the extrusion head moving at a radial speed, the motion of a radially moving extrusion head with respect to the rotating wafer is at a tangential velocity which is a constant tangential velocity;

extruding a ribbon of photoresist from the extrusion slot, the ribbon having a width which is substantially equal to the length of the slot, wherein the photoresist is extruded from the extrusion slot at a rate which is a constant extrusion rate, and

while extruding photoresist from the extrusion slot, and maintaining the extrusion slot aligned radially with respect to the wafer, moving the extrusion head radially inward from the outer edge of the wafer toward the center of the wafer until the photoresist covers the entire top of the surface of the wafer.

7. A method according to claim 6, wherein the length of the extrusion slot is between about one tenth and one third of the diameter of the semiconductor wafer.

8. A method according to claim 6, wherein maintaining the extrusion slot aligned radially with respect to the wafer further comprises uniformly maintaining the extrusion slot at a distance above the top surface of the wafer.

9. A method according to claim 6, wherein maintaining the extrusion slot aligned radially with respect to the wafer further comprises determining a distance between the extrusion slot and the top surface of the wafer, and adjusting the position of the extrusion slot to maintain the distance.

10. A method according to claim 9, wherein maintaining the extrusion slot aligned radially with respect to the wafer further comprises determining a distance between the extrusion slot and the top surface of the wafer using an optical sensor.

11. A method according to claim 6, wherein the photoresist ribbon is coated onto the wafer in a spiral pattern which covers the entire top surface of the wafer.

12. A method according to claim 11, comprising the steps of

removing the extrusion head, and

rotating the wafer at high speed.

13. The method of claim 1, wherein:

the substrate is a wafer having a top surface, a center, a diameter, and an outer edge;

mounting the substrate inside an enclosed housing comprises mounting the wafer on a chuck; and

extruding the polymer solution comprises:

positioning an extrusion head at the center of the wafer and above the top surface of the wafer, the extrusion head configured to extrude photoresist out an extrusion slot, the extrusion slot having a length bounded by a first end and a second end, the extrusion head positioned with the extrusion slot aligned radially with respect to the wafer, the first end of the extrusion slot located at the center of the wafer and the second end of the extrusion slot located between the center of the wafer and the outer edge of the wafer,

rotating the wafer about its center wherein with the wafer rotating at a rotational speed, and the extrusion head moving at a radial speed, the motion of a radially moving extrusion head with respect to the rotating wafer is at a tangential velocity which is a constant tangential velocity,

extruding a ribbon of photoresist from the extrusion slot, the ribbon having a width substantially equal to the length of the slot, wherein the photoresist is extruded from the extrusion slot at a rate which is a constant extrusion rate, and

while extruding photoresist from the extrusion slot, and maintaining the extrusion slot aligned radially with respect to the wafer, moving the

extrusion head radially outward toward the outer edge of the wafer until the photoresist covers the entire top surface of the wafer.

14. The method of claim 1, wherein controlling a solvent vapor concentration comprises

passing a first solvent vapor-bearing gas and a second gas to the housing along conduits in which electrically-controlled valves are mounted, the valves controlling a gas flow rate into the housing and the composition of the control gas flowing into the housing.

15. The method of claim 2, wherein controlling a solvent vapor concentration comprises

passing a first solvent vapor-bearing gas and a second gas to the housing along conduits in which electrically-controlled valves are mounted, the valves controlling a gas flow rate into the housing and the composition of the control gas flowing into the housing.

16. The method of claim 6, wherein controlling a solvent vapor concentration comprises:

passing a first solvent vapor-bearing gas and a second gas to the housing along conduits in which electrically-controlled valves are mounted, the valves controlling a gas flow rate into the housing and the composition of the control gas flowing into the housing.

17. The method of claim 13, wherein controlling a solvent vapor concentration comprises

passing a first solvent vapor-bearing gas and a second gas to the housing along conduits in which electrically-controlled valves are mounted, the valves controlling a gas flow rate into the housing and the composition of the control gas flowing into the housing.

18. The method of claim 1, wherein the control gas comprises at least one species selected from a group consisting of air, nitrogen, and noble gases.

19. The method of claim 2, wherein the control gas comprises at least one species selected from a group consisting of air, nitrogen, and noble gases.

20. The method of claim 6, wherein the control gas comprises at least one species selected from a group consisting of air, nitrogen, and noble gases.

21. The method of claim 13, wherein the control gas comprises at least one species selected from a group consisting of air, nitrogen, and noble gases.

22. The method of claim 1, wherein the polymer solution contains a photoresist polymer.

23. The method of claim 2, wherein the polymer solution contains a photoresist polymer.

24. The method of claim 6, wherein the polymer solution contains a photoresist polymer.

25. The method of claim 13, wherein the polymer solution contains a photoresist polymer.

26. The method of claim 1, further comprising passing solvent-free, humid gas over the coated substrate.

27. The method of claim 2, further comprising passing solvent-free, humid gas over the coated substrate.

28. The method of claim 6, further comprising passing solvent-free, humid gas over the coated substrate.

29. The method of claim 13, further comprising passing solvent-free, humid gas over the coated substrate.

30. The method of claim 26, wherein a humidity of the humid gas is controlled by means of a temperature and humidity controller.

31. The method of claim 30, wherein the humidity of a humid gas is controlled to have the relative humidity in the range of 40% to 45%.

32. The method of claim 1, wherein the temperature of the humid gas is controlled by means of a temperature and humidity controller.